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BIOLOGICAL SURVEY

of the

LOWER SPEED RIVER

1965

by

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INTRODUCTION

A biological survey of the lower Speed River was carried out in May, 1965 to provide data on water quality in addition to that obtained in the course of an assimilation study in August, 1965 by the Water Quality Surveys Branch.

The examination of biological communities of a watercourse provides information of practical use in the interpretation of water quality. The extent to which aquatic plant and animal communities are altered reflects the extent to which physical and chemical properties of water have been changed. Biological data tend to integrate physical and chemical parameters over a period of several months prior to the survey and place the interpretation of damage due to impaired water quality on a meaningful basis. Biological data also provide a useful basis to enable the detection of future changes in water quality.

SURVEY METHODS

Biological communities were examined at 15 stations. Two control stations were located above Guelph on both the Speed River and Eramosa River, four stations were located within Guelph and seven stations were located at intervals of from 1 to 3 miles downstream from Guelph.

Fish and bottom fauna were sampled at each station during the period from May 17 to 28, 1965. The following methods were used.

Bottom fauna

Two collections each consisting of ten minutes of uniform sampling effort in all common habitats were made at each station. A 20-mesh (per inch) hand sieve was used for making collections from bottom sediments and stream vegetation and organisms were hand-picked from larger stones in riffle areas. All specimens in each collection were separated from extraneous material by hand-picking, preserved in 95% ethanol and returned to the laboratory for identification and enumeration.

Fish

Ten seine hauls were made in a uniform manner at each station using a 50 x 4 foot seine of ¼-inch mesh. Collections were identified and enumerated in the field and a representative sample of all species taken at each station was preserved in 10% formaldehyde and returned to the laboratory.

The results of chemical analyses of water samples taken at nine of the biological survey stations during August 9 to 11, 1965 by the Water Quality Surveys Branch, are included in this report to illustrate the chemical quality of water during a period of dry-weather flow. A series of samples were collected at intervals of approximately four hours over a 48-hour period and returned to the laboratory for analysis. Concentrations of dissolved oxygen were determined on a similar series of samples. Determinations were made in the field using the azide modification of the Winkler method.

DESCRIPTION OF THE SPEED RIVER

The Speed River drains 302 square miles of Wellington, Halton, Waterloo and Dufferin counties. The stream rises in the township of Garafraxa East at a general elevation of 1475 feet and flows in a southerly direction for approximately 40 miles to its confluence with the Grand River near Preston at an elevation of 875 feet. The Eramosa River, which is the only major tributary of the Speed River, originates in the township of Erin and flows south for approximately 25 miles with an average gradient of 18.6 feet per mile to join the Speed River in Guelph.

Both the Speed and Eramosa Rivers flow through former glacial spillways which traverse rolling hills and swampy depressions. The upper portion of the watershed consists of sandy and gravelly hills. The Guelph drumlin field occupies a large area in the west and central portion of the basin and steeply sloping hills of the Paris moraine extend along the eastern boundary of the watershed.

Approximately 80% of the watershed is open land suitable for agricultural use. Fertile clay soils of the Guelph drumlin field are utilized for mixed farming. Light soils and steep relief in the eastern portion of the basin limit the value of these lands for agricultural

use. Much of this land is wooded, has been reforested or is maintained as permanent pasture. Valley lands have remained largely under tree cover because of poorly drained bottom lands and gravelly slopes and terraces unsuitable for agricultural use.

Population on the watershed is concentrated along the lower 15 miles of the Speed River in the municipalities of Guelph, Hespeler and Preston.

Figure 1 shows the location of sampling stations, urban centers and major sources of municipal waste discharges along the lower portion of the Speed River.

The lower 15 miles of the Speed River has an average gradient of 9.2 feet per mile. The stream consists of alternating riffles of stones and gravel and evenly-flowing silted sections. Streamflow data were obtained from guages at stations B and H operated by the Water Resources Branch, Department of Northern Affairs and National Resources. The average mean monthly flow at station H for the period 1950 to 1965 ranged from 440 cubic feet per second in April to 65 cubic feet per second in August and September. Substantial seasonal fluctuations in streamflow is characteristic for the Speed River above Guelph as opposed to the relatively uniform flows in the Eramosa River. Fine clay soils and a large percentage of open land on the upper Speed River basin result in a

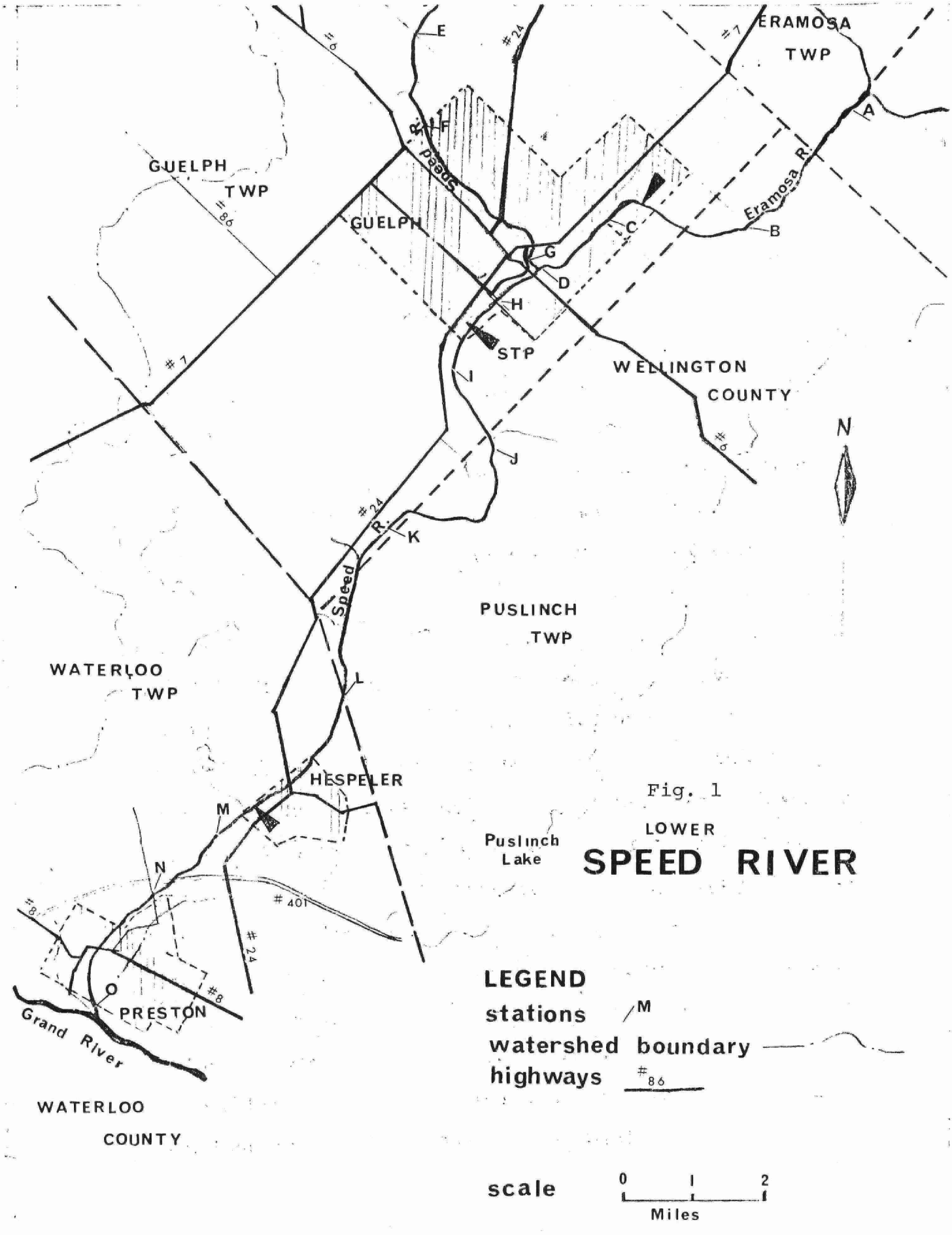

ERAMOSA
TWP
GUELPH
TWP
GUELPH
Speed R.
Eramosa R.
STP
WELLINGTON
COUNTY
N
PUSLINCH
TWP
WATERLOO
TWP
HESPELER
Puslinch
Lake
LOWER
SPEED RIVER
PRESTON
Grand River
WATERLOO
COUNTY
#6
#24
#7
#86
#401
#8
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
LEGEND
stations
watershed boundary
highways
scale
0
1
2
Miles

Fig. 1

rapid discharge of rain and melt-waters whereas coarser soils and a greater percentage of forested area on the Eramosa watershed permits a more gradual release of water to the stream-course. Steady summer flows are also maintained by the greater number of spring-fed tributaries of the upper Eramosa River.

During the peak run-off in April, 1965, the mean monthly flows at station H and B and at station G (by difference) were 895, 371 and 524 cubic feet per second respectively. Average flows during the summer sampling period (august 9 to 11) were 54, 32 and 22 cubic feet per second and during the period of the biological survey (May 17 - 28) were 141, 70 and 71 cubic feet per second. Streamflow in May at station O below Preston was estimated to be in excess of 200 cubic feet per second.

The Guelph sewage treatment plant, an activated sludge plant with a secondary capacity of 6.0 mgd., receives wastes from a population of 49,000 and a number of industries. The secondary effluent of approximately 4.8 mgd is chlorinated and discharged to the Speed River 100 yards upstream from station I. By 1964 most of the industrial wastes were being directed to the municipal plant. However, at the time of the biological survey in 1965, high BOD wastes from a number of industries including Hart Products, Mathew Wells Ltd., and Fiberglass Co., Ltd.,

were still being discharged directly to the Eramosa River upstream from station D and caustic cleaning water (Standard Brands) to the Speed River below station H.

Domestic wastes from the Ontario Reformatory in Guelph are treated by a trickling filter plant with a capacity of 0.5 mgd. The treated effluent with an average flow of 0.22 mgd, is discharged chlorinated to the Eramosa River downstream from station B.

The total of treated and untreated municipal wastes discharged to the stream in Guelph has been estimated to be 7.5 mgd (Grand Valley Conservation Authority, 1965).

Only limited treatment in the form of sedimentation and underdrained sand filterbeds (not used during winter months) is provided for domestic and certain industrial wastes originating from Hespeler. The system has a design capacity of 0.3 mgd, but in 1965 was treating an average volume of 0.4 mgd. No chlorination is provided. In addition, untreated wastes from two textile mills contribute an average total of 2500 pounds of 5-day BOD per day to the stream and acid wastes (pH 3.0) from a plating process are also discharged untreated to the stream at a rate of 0.025 mgd. The total discharge of wastes from Hespeler has been estimated at 2.7 mgd. (Grand Valley Conservation Authority, 1965).

Municipal wastes from the town of Preston are discharged to the Grand River following secondary treatment and chlorination.

BIOLOGICAL ASSESSMENT OF WATER QUALITY

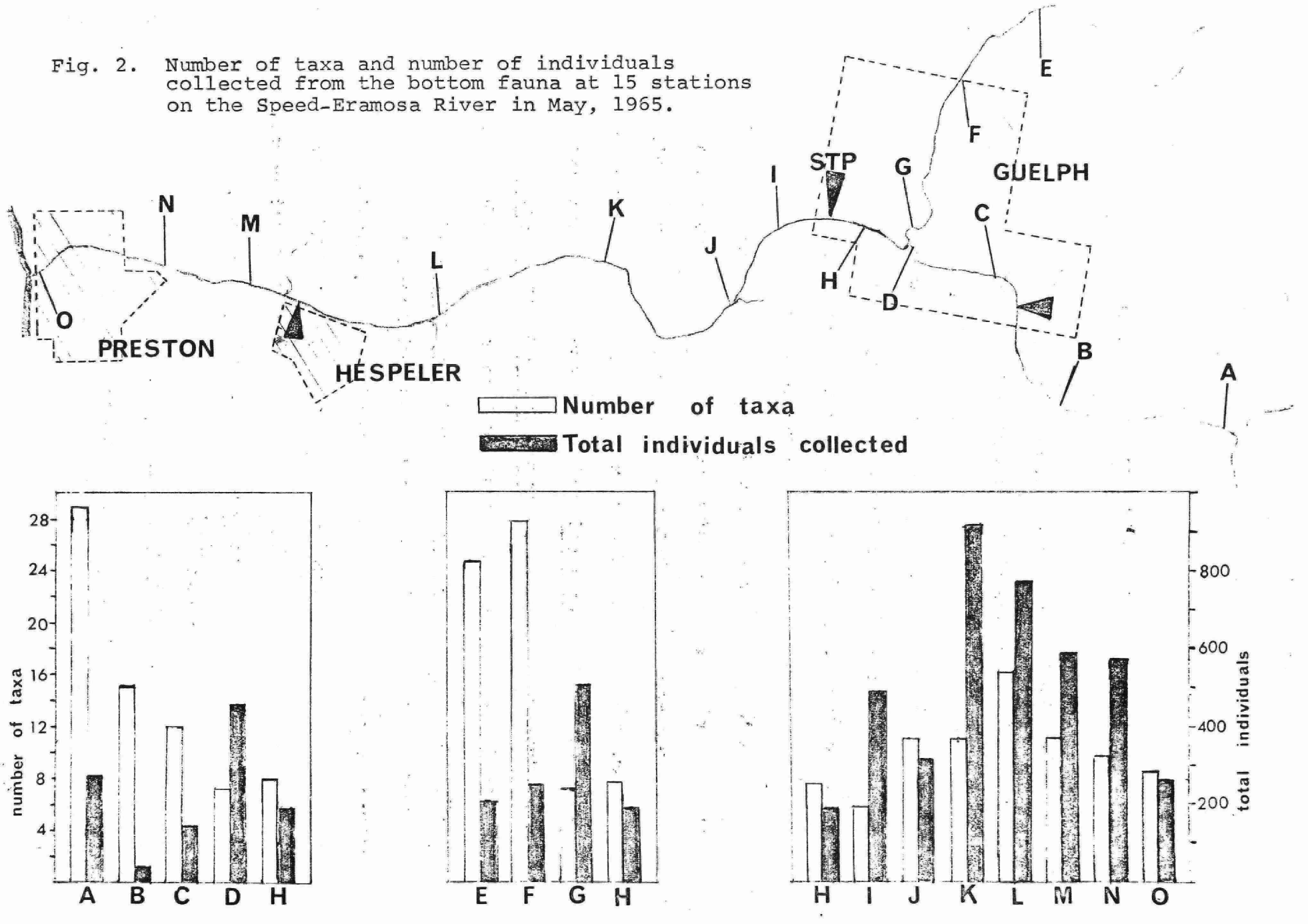
Bottom fauna

Changes in the structure of bottom fauna communities in the stream from above Guelph downstream to Preston are illustrated in Figure 2.

At control stations A, B, E and F, an average of 24 taxa were collected per station representing well-balanced communities typical of unpolluted warm water streams in Southern Ontario.

Impaired water quality was evident in both the Speed River and Eramosa River within Guelph. At station C, below waste discharges from the Ontario Reformatory, the bottom fauna was represented by only 12 taxa but included relatively intolerant mayflies (Baetis) and caddisflies (Hydropsyche and Cheumatopsyche). A further reduction in the number of taxa to 7 was noted at station D. Snails (Physa and Helisoma), one leech (Glossiphonia) and large numbers of midge larvae (Chironomidae) and sludgeworms (Tubificidae) were collected. The increase in the standing crop of bottom fauna and the unbalanced nature of the community at this station resulted from organic enrichment from upstream discharges of domestic and industrial wastes. Similarly at station G collections revealed the presence of only 7 taxa and an abundance of midge larvae and sludgeowrms. From a comparison of the structure of the

Fig. 2. Number of taxa and number of individuals collected from the bottom fauna at 15 stations on the Speed-Eramosa River in May, 1965.



bottom fauna community at this station with that observed at control stations E and F, impairment of water quality within Guelph was apparent. Little improvement was noted at station H where only 8 taxa were collected. However, the reduction in the numbers of midge larvae and sludgeworms indicated a significant degree of assimilation of organic wastes above this point.

At station I immediately downstream from the Guelph sewage treatment plant, the bottom fauna was restricted to only six taxa but further downstream through stations J, K and L considerable improvement in water quality was indicated by the gradual increase in the number of taxa to 16. Large standing crops of bottom organisms, particularly sludgeworms (Tubificidae and Naididae) illustrated the high level of productivity as a result of enrichment from waste discharges at Guelph. The presence of mostly tolerant and moderately tolerant organisms and the absence of most clean-water forms indicated only partial recovery at station L.

At stations M and N below Hespeler, the variety of bottom fauna was reduced to 12 and 10 taxa respectively and remained restricted below Preston at station O. The abundance of organisms, comprised largely of midge larvae, at stations M and N was indicative of excessive artificial enrichment from organic wastes discharged to the stream at Hespeler. However, a high degree of assimilation of these

wastes was indicated by reduced numbers of organisms at station O.

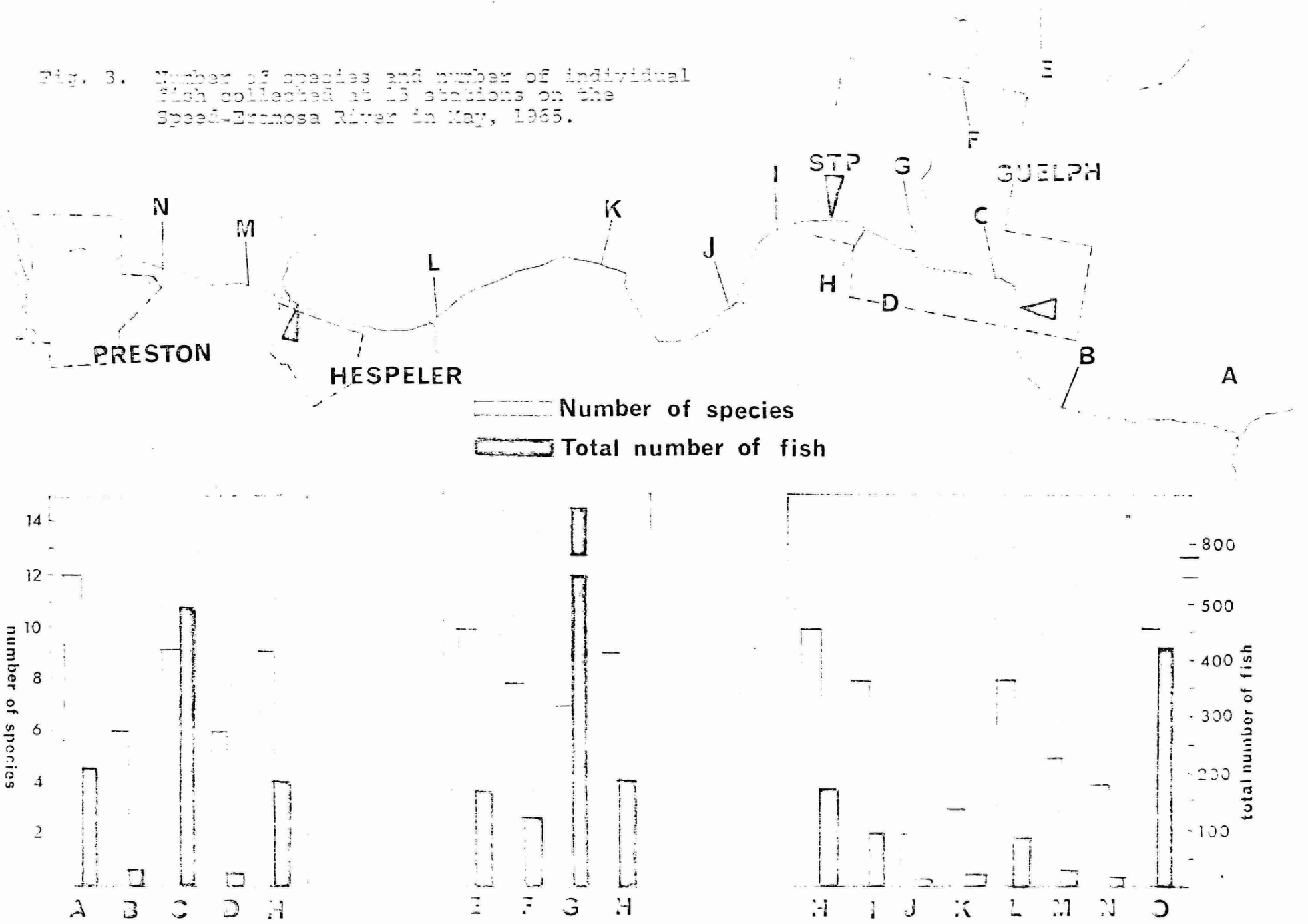
Fish populations

Data on the number of species and relative abundance of fish populations are presented in Figure 3. At the time of the survey a variety of species was collected at all stations upstream from the Guelph sewage treatment plant. Fish populations at stations C, D, G and H were similar to those observed at control stations. However, it may be speculated on the basis of bottom fauna data obtained at these stations that fish populations are restricted in this portion of the river to only the most tolerant species during periods of low flow. The adverse effect of discharges from the Guelph sewage treatment plant and of waste discharges from Hespeler on downstream fish populations was apparent with only a few tolerant species taken at stations J, K, M and N. In each case considerable improvement was indicated by the greater number of species taken at stations L and O.

A summary of the results of chemical determinations made on samples collected during the August survey are included in Tables 1 and 2. These data generally support the observations based on bottom fauna data obtained in May.

Levels of BOD were elevated below waste discharges from the Ontario Reformatory, Guelph sewage treatment plant and Hespeler. Concentrations of nutrients, total

Fig. 3. Number of species and number of individual fish collected at 15 stations on the Speed-Eramosa River in May, 1965.



phosphorus and Kjeldahl nitrogen were also elevated at these locations and remained above normal at all stations below Guelph. The adverse effect of increased fertility was evident from the excessive production of unsightly, filamentous green algae (Cladophora) observed throughout the lower portion of the river. The high respiratory oxygen demand exerted by such growths during nighttime periods may seriously reduce dissolved o ygen concentrations below that necessary to maintain a variety of aquatic life. Also, subsequent decomposition results in increased levels of BOD in downstream areas and obnoxious odours detrimental to the amenities of the watercourse.

Concentrations of dissolved oxygen (Table 2) were reduced in and below Guelph. The low minimum levels observed at most stations below Guelph are inhibitory to all but the most tolerant fish and bottom fauna organisms. The effect of prolific growths of algae on dissolved oxygen concentrations was illustrated by the wide range between maximum and minimum values observed at stations L and N.

SIGNIFICANCE OF BIOLOGICAL RESULTS

Results of the biological survey revealed impaired water quality of the Speed and Eramosa Rivers within Guelph and gross organic contamination below Guelph and Hespeler. Only partial recovery was indicated at station L approximately 9 miles below Guelph and impaired water

quality prevailed throughout the remainder of the river below Hespeler. The adverse effect of nutrient-rich waste discharges in promoting excessive production of filamentous algae throughout most of the lower river was apparent.

The Grand Valley Conservation Authority (1965) has proposed the construction of four multipurpose reservoirs, two on the Eramosa River, one on the Speed River above Guelph and one below Guelph. The management of these reservoirs for flood-water storage and augmentation of low summer flows will result in somewhat improved water quality conditions in the lower river. Recreational use of lands adjacent to these reservoirs has also been proposed. The reservoir upstream from Guelph on the Speed River will be maintained at a constant level for maximum recreational use and should provide an excellent sport fishery. Artificial enrichment by waste discharges from Guelph will seriously reduce the value of the downstream reservoir as a recreational facility.

Attention should be given to the incorporation of all industrial wastes and domestic wastes from the Ontario Reformatory into the Guelph sewerage system for treatment at the municipal plant. As well, the need for adequate treatment of both domestic and industrial wastes in Hespeler is apparent.

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Table 1. Summary of chemical and bacterial determinations made on samples collected at eight stations on the Speed River and one station on the Eramosa River by the Water Quality Surveys Branch on August 9, 10 and 11, 1965.[1]
(All results except coliforms reported as ppm)

Station [2]		5-day BOD	Solids			Total phosphate (as PO_4)	Free ammonia (as N)	Total Kjeldahl (as N)	Coliforms per 100 ml (M.F.)
			Total	Susp.	Diss.				
1	(F)	1.5	286	6	280	0.16	0.07	0.71	1,875
2	(G)	3.4	325	8	317	0.37	0.15	1.08	33,750
3	(H)	3.7	418	15	403	0.95	0.38	1.50	32,175
4	(C)	7.0	412	8	404	3.10	0.82	1.80	180,075
6	(J)	8.7	493	5	488	1.92	1.70	2.70	1,283
8	(K)	3.0	503	11	492	1.60	0.41	1.30	70
10	(L)	3.6	514	15	499	1.80	0.27	1.15	1,010
12	(M)	6.3	586	23	563	3.30	0.13	1.97	145,900
14	(N)	3.4	550	10	540	2.92	0.34	1.50	12,690

1 Results are averages of determinations on from four to twelve samples

2 Biological survey stations in parentheses

Table 2. Average and range of dissolved oxygen at eight stations on the Speed River and one station on the Eramosa River. Results were obtained from determinations made every four to five hours through the period of August 9 to 11, 1965.

Station[2]	Dissolved Oxygen[1] Average	Maximum	Minimum
1 (F)	8.5 (91)	12.0 (134)	6.0 (55)
2 (G)	7.3 (79)	10.0 (115)	4.0 (43)
3 (H)	6.9 (76)	10.0 (113)	5.0 (52)
4 (C)	8.7 (93)	12.0 (108)	7.0 (73)
6 (J)	2.4 (25)	5.0 (54)	1.0 (10)
8 (K)	4.4 (50)	6.0 (70)	2.0 (22)
10 (L)	8.2 (94)	13.0 (144)	3.9 (36)
12 (M)	6.6 (75)	9.8 (101)	4.0 (45)
14 (N)	10.6 (122)	24 (284)	2.8 (30)

1 expressed as ppm (per cent saturation in parentheses)

2 Biological survey stations in parentheses

APPENDIX

Table 1. Collections of bottom fauna at 11 stations (A to O) on the Speed-Eramosa River during the period of May 17 to May 28 1965. The collecting methods are outlined in the text of the report. Collections are designated as items 65B1 to 65B30 in the permanent collection of the Biology Branch.

	Stations																															
	A		B		C		D		E		F		G		H		I		J		K		L		M		N		O	
Taxa	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
STONEFLIES																																
Acroneuria	8																															
Arcynopteryx	1																															
Togoperla									1																							
MAYFLIES																																
Baetis	2	6	2	1	6				4	3	7	10		3																		
Paraleptophlebia	8	2										2																				
Ephemerella	11	34	2	1						3	1	11	1									1			1							
Pseudocloeon	4	1							6	9	16	28	1	5													1					
Stenonema	1		1	5					10	1	10	16																				
Caenis		1	3	1					6	1	7									1												
Siphlonurus							1																									
Unidentified			1																													
CADDISFLIES																																
Hydropsyche	6	6		1		1			15	3	1	1																				
Cheumatopsyche	13	6	2		1				7	2	9	6																				1
Helicopsyche	1	5	4						10	17	8	10																				
Chimarra		1	1						1		1	1																				
Glossosoma		1																														
Neureclipsis		1																														
Pycnopsyche	1	1		1					1	1	3			1																		
Neophylax	2									1																						
Micrasema		4																														
Oecetis									5	1		2																				
Mystacides										2		1																				
Hydropsychidae (pupae)	8	1	1						19	6	9	20																				

TABLE I (Cont.)

Taxa	Stations A I	A II	B I	B II	C I	C II	D I	D II	E I	E II	F I	F II	G I	G II	H I	H II	I I	I II	J I	J II	K I	K II	L I	L II	M I	M II	N I	N II	C I	C II
DRAGONFLIES																														
Gomphus		1																												
Agrion											1	2																		
Enallgma											1	1									1			3				1		
Aeshna													1																	
DAMSELFLIES																														
Ischnura								2														2	1	3		1	2			
FLIES																														
Chironomidae	47	45	8	3	25	60	102	25	38	15	22	19	157	182	76	90	234	50	57	35	115	100	97	52	165	354	161	246	111	85
Atherix	1	3																												
Antocha	4	3																												
Simulium												3																		
Eristalsis																									1					
BEETLES																														
Stenelmis	1	1	2			1					2																			1
Psphenus									2	2	1												1							
unidentified adults	10	6	2						1	1	5	5											1							
BUGS																														
Corixidae		6																												
Notonectidae																						1								
AMPHIPODS																														
Hyallela												1							3	4			2		4	7	35	4		
Cranonyx																			4	9	7	4	1							

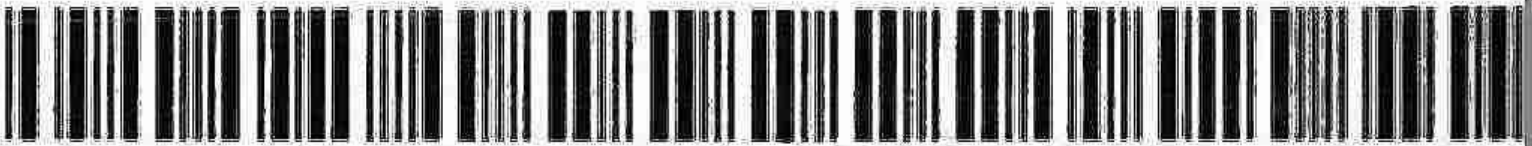
APPENDIX

Table 2. Total catches of fish from 10 seine-hauls at each of 15 stations on the Speed and Eramosa Rivers, May, 1965.

Species	Stations														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Central mudminnow												1			
White sucker	74			1	1	5	251	14	5	1				1	97
Northern hog sucker		3	1		1	8									
Northern redhorse sucker															5
Fathead minnow	1							25	1			30	14	1	91
Bluntnose minnow	8	3	27		8	12	3	41	45	1	1	16	2		74
Common shiner	25	15	370	20	40	27	569	31	4		1		6		108
Golden shiner												2	1		3
Creek chub	33	1	15	6	54	42	10	11	11			1			9
Hornyhead chub	4	5	63												
Redbelly dace	1		6		11			18	8			10		3	28
Blacknose dace					3		3	2							
Longnose dace							3	2							
Brown bullhead													2		
Brook stickleback				1	32	19		3	22		1	12		1	5
Rock bass				1	1	7	7								
Pumpkinseed	4											10			
Smallmouth bass					11	9									
Rainbow darter	6	4	2												
Barred fantail darter			1												
Blackside darter	9														
Johnny darter	43		8	1											
Least darter									1						
Mottled sculpin	2														
Rosyface shiner															1
Total number of fish	210	32	493	30	152	129	846	177	97	2	3	82	25	5	421
Total number of species 25	12	6	9	6	10	8	7	9	8	2	3	8	5	4	10

TABLE I (Cont.)

Taxa		Stations A I	A II	B I	B II	C I	C II	D I	D II	E I	E II	F I	F II	G I	G II	H I	H II	I I	I II	J I	J II	K I	K II	L I	L II	M I	M II	N I	N II	O I	O II
LEECHES																															
Helobdella						2	1																4	4	8				2		
Glossiphonia								1																	4	1		1	1		
unidentified	A															2			1	3		4	3	1						4	2
	B															1			2	3	2									1	
	C																1														
	D											1									2				1						
	E																	1								2	2	4	8		1
	F																				2										
	G																				1										
	H																								2						
	I																											1			
MOLLUSCS																															
Physa						4	3	8	5	1							1														
Ferrissia							1					1																			
Helisoma								4	3																						
Campeloma																										11	1				
Sphaerium			2	1						1	1																				
Pisidium						3	1				4	6											1	1							
Lasmigona																											1				
Elliptio																									1						
Goniobasis						1	4																								
Alasmedonta										1			1																		
CRAYFISH																															
unidentified		1	1													1															
SLUDGEWORMS																															
Lumbriculidae										1														1			1				
Naididae										7						4	10	20	40	60	80	440	210	320	220	9	29	73	35	20	37
Tubificidae			1			2	32	140	188	2				80	83	1	2	90	51	39	16	6	14	31	21	5				1	1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